CASE REPORT

Eastern Journal of Medicine

East J Med 28(2): 365-368, 2023
DOI: 10.5505/ejm.2023.90592

The Importance of Radiological Imaging In The Medicolegal Evaluation of Gunshot Wounds: A Case Report

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ABSTRACT

Determining the shooting direction in gunshot wounds is very important, especially in cases where the number of suspects is more than one. In cases of gunshot wounds, a detailed anamnesis should be taken and an examination should be performed, it should be investigated whether the injury caused a bone fracture, and the diagnosis should be confirmed by radiological examinations. With the use of radiological examinations, the direction of the shot can be determined by evaluating the appearance of the metal fragments separated from the bullet core, which crashes into the bone tissue and bone fragments. Radiological imaging of a 32-year-old male patient who was injured in the left leg area with a firearm and was sent to Forensic Medicine Department of Medical School of Manisa Celal Bayar University to determine the shooting direction was evaluated. The case, whose entrance-exit holes were distinguished and the direction of the shot was determined by radiological imaging, is presented to guide the medicolegal evaluation.

Keywords: Gunshot wounds, radiological imaging, bone fracture, shooting direction

Introduction

The use of X-ray in forensic medicine began just a few weeks after its discovery. In 1895, a bullet in the leg of a victim in Canada was identified by radiography and presented to the court as evidence (1). Another application of X-ray methodology was in England in 1896 by Schuster, in a case of gunshot wound of a woman (2).

If the wound charaeristics in gunshot wounds are not defined in detail, it may be difficult to detect the entrance-exit holes and to determine the direction of the shot. In gunshot wounds, determining the direction and level of the shot is very important in cases where the number of suspects in the incident is more than one (3). Due to the fact that part or all of the human body is mobile, it may be difficult to determine from which direction and level the shot is made (4).

In cases where the injury causes a bone fracture, radiological examinations can be used. In cases of gunshot wounds, a detailed anamnesis should be taken and an examination should be performed, bone fractures should be investigated, and the diagnosis should be confirmed in radiological examinations. The radiological evaluation provides information about whether there is a bone fracture, its localization and the shape of the fracture, if any, and the appearance of the metal fragments separated from the bullet core, which is shattered by hitting the bone tissue and broken bone fragments, can guide the determination of the direction of the entrance and exit holes of the shot (4,5).

If the bullet of the firearm has created a fracture in long bones such as the femur, x-rays are taken in anterior-posterior and lateral positions, paying attention to which direction the broken bone fragments and small metal particles from the bullet have gone. The hole on the side where the parts go is the exit hole. Evaluation of the entrance-exit holes is relatively easier in double-laminated flat bones such as the cranium, iliac, and scapula. When we look at the features of these holes, the entrance hole is smaller, the edges are smooth and sharp, the exit hole is larger, and it is seen in the form of a crater as a result of the ring-shaped fracture of the surrounding bone (4).

Although it was stated that the bullet had entered the lateral side of the left leg and exited from the medial side in the examination performed in the emergency room as a result of a gunshot injury of

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Received: 16.03.2022, **Accepted:** 18.07.2022

Fig. 1. Two lesions in the left leg: a; lateral side; **b;** medial side

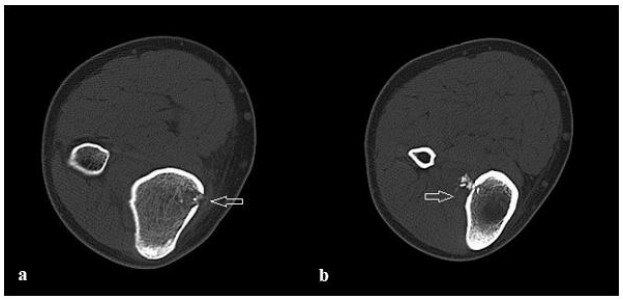

Fig. 2. CT images, axial plane: a; inward distortion in the bone cortex in the medial part of tibia due to entry of the bullet core, **b;** bone fragments concentrated in the lateral part of tibia due to exit of the bullet core

the presented case, when the images taken were evaluated, it was medically concluded that the bullet had entered the body from the medial side, contrary to the findings described.

Case Report

A 32-year-old male case was sent to Forensic Medicine Department of Medical School of Manisa Celal Bayar University for the purpose of determining the shooting direction and preparing a report by the local court. In the report prepared in the emergency room on the date of the incident, it was reported that he had a gunshot wound and that, in his physical examination, there was an entrance hole in the outer face of the left leg in the midline and an exit hole under the kneecap. And the radiologist's interpretation in the computed tomography (CT) report was that in the proximal metaphyseal part of the tibia, a possible gunshot injury that causes fragmentation in the bone cortex with medial entrance and lateral exit is observed. In the examination performed in Forensic Medicine Department of Medical School of Manisa Celal Bayar University one month after

Fig. 3. CT images, coronal plane: a; disruption of the integrity of the bone cortex in the medial part of the left tibia, **b;** outward density of the bone fragments in the lateral part of the left tibia

the injury; consistent with the localizations described, two lesions were detected in the left leg 1/3 upper part medial surface, four centimeter below the patella, and left leg 1/3 middle part lateral surface, 10 centimeter below the patella, with a diameter of 1 centimeter, hyperemic around, and a crusted in the middle (Figure 1).

In the evaluation of the CT and X- ray imaging of the case taken at the time of the incident, it was determined that there was a fracture in the medial part of the upper 1/3 of the left tibia, which disrupted the cortex integrity, and bone fragments were dense in the lateral part (Figure 2-3). As a result of this radiological evaluation, it was understood that the lesion, which was described as an entrance hole in the examination performed in the emergency room, was an exit hole.

Discussion

Radiological imaging techniques are used as an important tool in forensic investigations (6,7). Forensic radiology applications cover many topics, including estimating bone age, determining the causes of death or injury, documenting the type and mechanism of traumatic injuries, and detecting explosives. In particular, CT examinations of gunshot wounds have become more widely used than invasive surgical procedures to determine the tracing and location of bullet cores (8,9).

Gunshot wounds are very common in forensic medicine practice. In order to make accurate reporting in forensic cases, the first physician must conduct the process correctly. In this process, the findings obtained by detailed anamnesis, physical examination and radiological

imaging requested according to the nature of the event are evaluated and recorded (10). In addition to the clinical evaluation of gunshot wounds, radiological findings can also help forensic processes, especially by used in determining the tracing of the bullet. Examining physicians can sometimes be mistaken in distinguishing between bullet entry-exit lesions. With radiological imaging, this distinction can be made more accurately and thus, problems that may be encountered in forensic processes can be avoided. In cases with bone defect, bullet fragments and bone fragmentation tend to be distributed beyond the defect within the soft tissues. Careful analysis of radiological imaging also contributes to revealing the tracing of the bullet (11). Advanced three-dimensional techniques and multi-sectional radiological imaging can be used to detect injuries in soft tissues, parenchymal organs and bones, as well as easily localize the bullet and its parts in the body, and detect the wound mechanism and the trajectory of the bullet (12).

In a case of death by firearm by Del Fante et al., with postmortem CT evaluation; It has been reported that the entry and exit points of the bullet, the trace of the bullet, internal organ injuries and bone fractures were determined and legal authorities were assisted about how the incident took place (13).

Determining and defining the anatomical localizations, dimensions and morphological features of the wounds during physical examination in forensic medicine applications provides great convenience to the forensic medicine specialist in the process of writing a forensic report (4,14). However, radiological methods should be used, as it would not be appropriate to determine the direction of the shot and trace by only looking at the skin findings in gunshot wounds with entry-exit holes in clothing areas (15).

In a case of gunshot wound, DiMaio detected two wounds caused by bullet on the lateral and posteriomedial faces of the victim's left leg, but stated that both wounds showed similar characteristics, were circular in appearance, and did not have a striking ring around them. Fracture of the fibula and bone fragmentation showing outward distribution from the fibula in X-ray images showed that the bullet entered the posteriomedial face and exited from the lateral (16).

In our case, although it was stated that there was an entrance from the lateral aspect of the left leg in the midline and an exit hole 4 centimeter below the kneecap, the detailed features of the wounds were not defined and the striking ring was not described. In the examination of the images taken in Forensic Medicine Department of Medical School of Manisa Celal Bayar University, the bone fragments were observed to show density in the lateral part in the upper 1/3 of the left tibia, and it was concluded that the bullet core entered from the medial and exited from the lateral (Figure 2-3). With radiological examinations, both bone fractures were observed and the shooting direction could be determined by distinguishing the bullet entry and exit holes.

In gunshot wounds, detailed history including the occurrence of the event, clinical findings, physical examination and radiological imaging should be evaluated as a whole, and it should be investigated whether the bullet hit the bone and whether it caused a bone fracture. Precise statements such as the entrance and exit hole should be avoided in the emergency services, and detailed documentation of the findings may be very important for the subsequent judicial process. As in our case, it would be more appropriate to condu a medicolegal evaluation after the separation of the entrance and exit holes according to the density of the metal fragments separated from the bullet core and bone fragments and the direction of the shot are determined radiologically.

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